Manual

# LDM41P and LDM42P

## Version 3.4

CE

Dear User,

You are advised to carefully read this User Manual before powering on the LDM41P and LDM42P Laser distance measuring sensor for the first time.

This is necessary to ensure that you will be able to utilize all the capabilities and features which your new acquisition provides.

This technology is subject to continuously ongoing development.

| | |
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Note:

Proper care has been used in compiling this document. No liability will be accepted in the event of damage resulting from failure to comply with the information contained herein.

## Revisions history

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| 3.4 | 16.03.2015 | New design |

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# 1 General

The LDM41P AND LDM42P are Laser sensors to measure distances from 0.1 m to more than 100 m with pinpoint accuracy.

A given target can be clearly identified with the help of a red Laser sighting point. In terms of operating reach, the LDM41P and LDM42P performs depending on the reflectance, morphology and qualities of the target to be measured.

The sensor works based on comparative phase measurement. It emits modulated Laser light which is diffusely reflected back from the target with a certain shift in phase to be compared with a reference signal. From the amount of phase shift, a required distance can then be determined with millimeter accuracy.

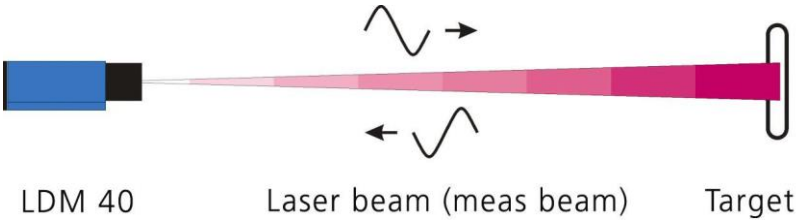



**Figure 1 : Measurement principle**

A distance measuring cycle can be triggered in three different ways:

- By sending a command from the PC or another equivalent control unit
- By making appropriate prior parameter settings for the auto start command and applying supply voltage
- By external triggering (in remote-trigger mode).

For a more detailed description of these three trigger options, you should consult chapter 8, Parameters and Control via RS232 of this User Manual.

**Special performance features are:**

- Provides high accuracy and great reach under extreme outdoor temperatures.
- Works in a wide range of operating voltages from 10 V= to 30 V= from an on-board vehicle supply point, an industrial direct voltage supply net or a DC power pack.
- Features consistently low power consumption of <3.5 W[1] (without $I_{Alarm}$)
- Up to 30 m reach for distance measurement, with potential for more than 100 m reach if additional reflectors[2] are mounted onto the target (depending on reflectance and environmental conditions).
- Visible Laser beam for easier sighting.
- Output and control via Profibus DP
- Measured values can be displayed in meters, decimetres, centimetres, feet and inches due to.
- Option for remote triggering of a measurement from an external trigger device.
- Large range of accessories available

[1] inactive internal heating for devices with internal heating (LDM41P-h and LDM42P-h)
[2] e.g. 3M, self adhesive foil white non glossy or foil 3290 for longer distances

# 2 Safety Instructions

## 2.1 General Safety Instructions

These safety and operating instructions should be carefully read and followed during practical work with the LDM41P and LDM42P.

There is danger of Laser radiation or electrical shock. For necessary repair work, the LDM41P and LDM42P may not be opened by anyone other than Manufacturer personnel. Unauthorized intervention into the inner product space will void any warranty claims.

Compliance with all specified operating conditions is necessary.

Failure to observe advisory notes or nonconforming product usage may cause physical injury to the user or material damage to the LDM41P and LDM42P.

Cable connectors must not be plugged or unplugged under voltage. Remember to turn voltage supply off before you begin working on cable connections.

## 2.2 Intended & Conforming Use

- Measurement of distances
- Special measuring functions
- Compliance with prescribed temperatures for operation/storage
- Operation at correct voltage level
- Application of specified signal levels to the appropriate data lines

## 2.3 Nonconforming use

- Do not operate the LDM41P and LDM42P in any other way than described under "Intended & Conforming Use" above and only in a proper working condition
- Safety devices must not be defeated or otherwise rendered ineffective
- Information and warning signs must not be removed
- Repair work on the LDM41P and LDM42P must not be carried out by anyone other than authorized personnel.

- Refrain from using the LDM41P and LDM42P without certified protection in an explosive environment
- Measurement with the LDM41P and LDM42P pointed at the sun or other strong light sources may produce faulty results
- Measurement of targets with poor surface reflectance in a strongly reflecting environment may also result faulty measurements.
- Measurement of strongly reflecting surfaces may deliver faulty results.
- Measurement performed through transparent optical media, for example glass, optical filters, Plexiglas, etc. may equally produce incorrect results.
- Measurement on translucent objects (materials allow light to pass through, but are not transparency, e.g. polystyrene, wax, different plastics etc.) can give a too large measured value, since also light is reflected by deeper layers
- Rapidly changing measuring conditions are likely to falsify the result of measurement

## 2.4 Laser Classification

The LDM41P and LDM42P is a Class 2 laser product, ≤1 mW as stipulated in EN60825-1:2007, Class 2.

**Caution:**

**There is Class 2 Laser radiation. Do not stare into beam!**

**Figure 2 : Warning Sign Laser Radiation Class 2**

The Laser power is limited to maximum 1 mW. The Laser radiation is visible. A short-term exposure (duration up to 0.25 s) is harmless to the eye.

Users are instructed by Laser warning sign (see Figure 2) to do not stare into the beam. They have to protect themselves by turn the head and/or closing the eyes and by avoid a long look into the beam.

Do not direct the Laser beam onto persons.

**The sensor can use without any additional safety protection.**

## 2.5 Electric Supply

Use only 10 V to 30 V DC (direct voltage) for LDM41P and LDM42P operation. Use only the specially designated connector terminal for voltage supply.

Specified signal levels must not be exceeded, in order to guarantee correct data communication.

## 2.6 Important Operating Advice

To make full use of the system's inherent performance capabilities and achieve a long service life, you should always follow these operating rules:

- Do not turn the module on if there is fogging or soiling on its optical parts
- Do not touch any of the module's parts with bare hands.
- Proceed with care when removing dust or contamination from optical surfaces!
- Prevent shock impacts during transport and use of the LDM41P and LDM42P
- Prevent overheating of the LDM41P and LDM42P.
- Prevent major temperature variances during LDM41P and LDM42P operation
- In accordance with IP65 internal protection standards, the LDM41P and LDM42P is designed to be splash proof and dustproof.
- Read these safety and operating insturctions with due care and follow them in practical use.

# 3 Technical Data

**Table 1 : Technical data**

| | |
|---|---|
| Measurement range[3] | 0.1 m up to 30 m with natural surfaces, depending on target reflectance or reflectors more than 100 m achievable[4] |
| Measuring accuracy[5] | ±2 mm under defined measuring conditions[6]<br>±3 mm (+15 °C up to +30 °C)<br>±4 mm in DS mode <0.5 m (+15 °C … 30 °C)<br>±5 mm (-10 °C up to +50 °C) |
| Resolution[7] | 0.1 mm, user scalable, standard 1 mm |
| Reproducibility | ±0.5 mm |
| Measuring time | 0.24 to 6 s setup or auto Mode DT<br>0.1 s (10 Hz) mode DW at white surface<br>20 ms (50 Hz) mode DX at white surface<br>(only LDM42P) |
| Target motion speed | ≤4 m/s in DX-Mode (LDM42P only) |
| Acceleration | ≤2.5 m/s² in DX-Mode (LDM42P only) |
| Operating temperature | -10 °C up to +50 °C<br>-40 °C up to +50 °C (LDM41P-h and LDM42P-h only) |
| Storage temperature | -40 °C up to +70 °C |
| Supply voltage | 10 V ... 30 V DC (protected against polarity reversal)[8] |
| Power consumption | Depending on operation mode<br>< 2.5 W in Standby<br>< 3.5 W for distance tracking<br>< 24 W with heating active (only with -h option) |

[3] dependent on target reflectance, stray light influences and atmospheric conditions
[4] e.g. 3M, self adhesive foil white non glossy
[5] statistic spread 95 %
[6] for measurement at a planar white target surface in continues movement or still standing, +15 up to +30 °C
[7] dependent on target reflectance, stray light influences and atmospheric conditions
[8] Please use only 24V DC For devices with heating (LDM41P-h and LDM42P-h) The heater is connected directly to the power supply.

| | |
|---|---|
| Profibus interface | **Profibus DP norm slave**, auto detect up to 12 Mbit, ID Number **0x2079** (8313), **13 Byte IN, 1 Byte OUT** |
| Data interface | RS232, baud rate 9600 (2400..38400), ASCII, Format 8N1 (fix), **receive path is deactivated after connecting to the Profibus master!** |
| Digital switching output | „high-side-switch“, programmable switching threshold and hysteresis, rated for max. load of 0.5 A, HIGH = UB - 2 V, LOW < 2 V |
| Trigger input[9] | External trigger, trigger pulse 3 up to 24 V, pulse length≥ 1 ms, start of measurement 5 ms + trigger delay, trigger slope and delay can be set (0 ms ... 9999 ms), |
| EMC | EN 61326-1 |
| Shock resistance | 10 g / 6 ms<br>Persistence shock DIN ISO 9022-3-31-01-1 |
| Laser Class | Laser class 2, under EN60825-1:2007, Class 2 |
| Wave length | 650 nm (red visible) |
| Laser divergence[10] | 0.6 mrad |
| Laser angle tolerance | Better than ± 1° to the ground plane |
| Average service life | 100,000 h at 60 °C Laser temperature (intern) |
| Connector | 12-pol. M18-male socket, Binder Serie 423 |
| Dimensions (LxWxH) | 212 mm x 96 mm x 50 mm |
| Mounting | 100 mm x 85 mm, 4 x M6 holes |
| Weight | approx. 850 g |
| Protection class | IP 65 (spatter water and dust protection) |

[9] trigger function is not available for devices with internal heating (LDM41P-h and LDM42P-h)
[10] at 10 m distance the beam diameter is 6 mm, at a distance of 50 m it is 3 cm and at a distance of 100 m it is 6 cm

# 4 Mounting

The casing consists of a rugged, corrosion-resistant extruded aluminium profile with front-side and rear-side covers also of corrosion-resistant design. Four mounting holes are provided in the base plate for mounting the LDM41P and LDM42P.

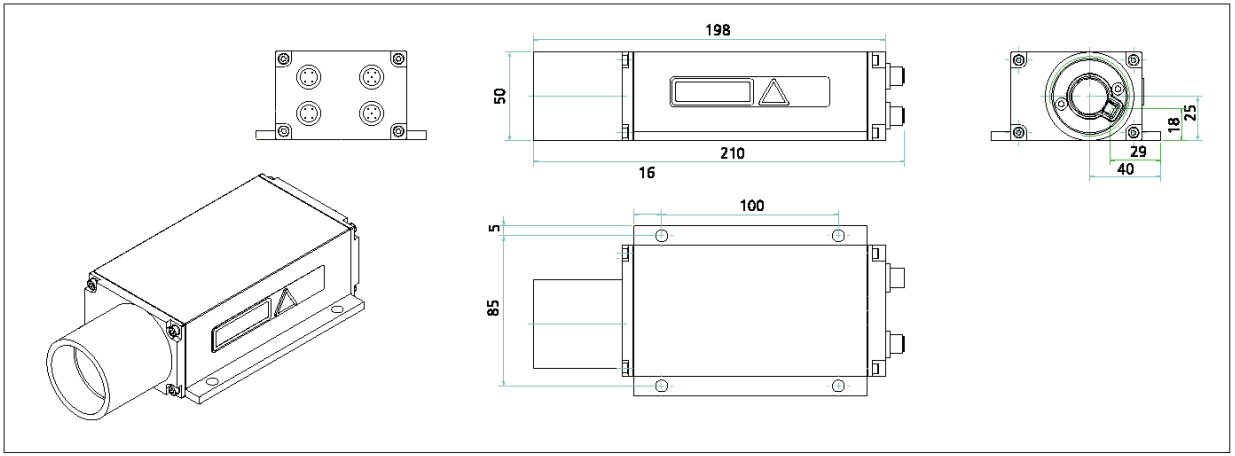



**Figure 3 : Mounting drawing**

To protect the range finder's optical surfaces from dust, physical contact and impacts, etc., a protection tube has been attached to the casing. Please note that measurement cannot be guaranteed to function correctly if the protection tube is removed incorrectly or by unqualified personnel!

The interface connector is located on the back cover. Interface cables with different length are available (standard 2 m, optionally 5 or 10 m).

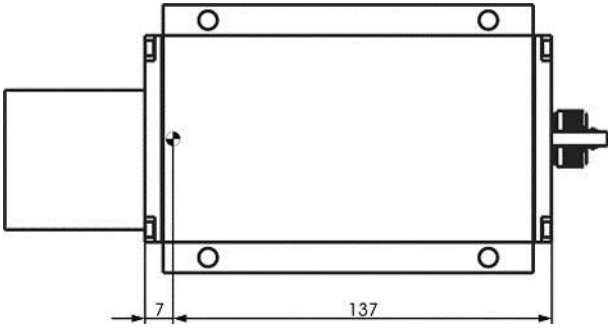



**Figure 4 : Offset against zero-edge**

The LDM41P and LDM42P's zero-point is located 7 mm behind the outer surface of the front cover or 137 mm before the back cover outside face respectively. This zero-point has been introduced for constructional design reasons. It can be compensated with the help of parameter "OF" (see section 8.22 OF – display/set distance offset)

# 5 Electrical Connection

## 5.1 LDMRear-Side Cover Terminals

Connector terminals are located on the rear-side cover of the device. The terminals consist of 4 buses for metal circular plug-in connectors (from Binder), or compatible connectors, sealed against the casing in compliance with IP 65 requirements. This connector type guarantees optimised screening and a high IP level.

The following connection plugs should be used:

**Table 2 : LDM41P and LDM42P terminals**

| Quantity | Connector Type | Use |
|---|---|---|
| 1 | 4-pin male cable connector (series 715 B from Binder) | Profibus DP Output |
| 1 | 4-pin female cable connector *) (series 715 B from Binder) | Profibus DP Input |
| 1 | 5-pin male cable connector (series 713 from Binder) | RS232 |
| 1 | 5-pin female cable connector (series 713 from Binder) | Power supply, trigger input and digital output |

*) until Dec. 2006 4-pin male cable connector

**Note:** Various connectors and cables are available. Please ensure that **only shielded connectors and shielded cables** are used.

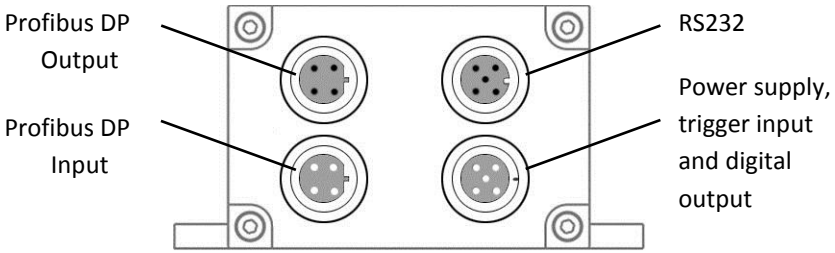



**Figure 5 : LDM41P and LDM42P terminals**

## 5.2 Assignment of Terminals

The required power supply is 10 to 30 V DC.

The trigger input allows for a distance measurement via an external signal in the form of a voltage impulse from 3 to 24 V (only DF mode, please see Chapter 8).

**Table 3 : Pin assignment power supply, alarm and trigger**

| Pin | Description | Colour | Comment |
|---|---|---|---|
| 1 | VCC | brown | Power supply 10 to 30 V |
| 2 | ALARM | white | Digital Output (≥ VCC – 2 V) |
| 3 | GND | blue | Power supply 0 V |
| 5 | Trigger | gray | Trigger input 3 to 24 V (ground potential GND) |

## 5.3 Profibus DP

The LDM41P and LDM42P has two terminals (input and output) for circular plug-in connectors (series 715 B for Profibus DP from Binder) conforming to the relevant standards.

**Table 4 : Pin assignment Profibus DP**

| Pin | Description | Comment |
|---|---|---|
| 1 | +UB | Power supply for active terminal resistance |
| 2 | A | Profibus signal line A (green) |
| 3 | 0 V | Power supply for active terminal resistance |
| 4 | B | Profibus signal line B (red) |

**Note:** Only use connection plugs and Profibus cables that conform to the relevant standards. If the LDM41P and LDM42P is to be connected at the end of the bus, then a terminal resistance must be connected to the output terminal for the Profibus DP.

## 5.4 RS232 Serial Interface

The RS232 interface was originally designed as a PC interface only. It has now become the standard for serial data transfer for short distances. It is subject to interference when used for longer distances, in particular, in environments

with interfering high-frequency electromagnetic radiance. As a result, this interface should only be used for configuring the LDM41P and LDM42P. Please configure using the programming cable and the LDMTool program.

Following successful configuration, remove the programming cable and protect the terminal with a sealing plug.

**Note:** Please configure the LDM41P and LDM42P prior to connecting the Profibus. **The receiving line of the RS232 serial interface is deactivated after connecting to the Profibus master.**

Please observe the RS232 standard. The maximum extension of the RS232 lines is 15 m.

**Table 5 : Pin assignment RS232**

| Pin | Description | Colour | Comment |
|---|---|---|---|
| 1 | RxD | brown | Receiving line |
| 2 | TxD | white | Transmit line |
| 3 | GND | blue | Ground potential |

**Note:** Following successful programming, remove the RS232 cable and protect the RS232 cable connector with the enclosed sealing plug against entry of dirt. If the cable is to remain connected to the device, then a terminal resistance must be attached.

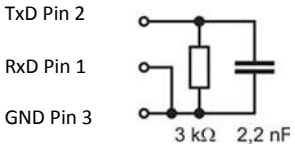



**Figure 6 : Termination RS232**

Ensure that no data line ends are left open, since they may be subject to interference (EMC).

A terminator circuit should be installed when the RS232 is unconnected.

This circuit must be provided by the customer (see diagram on the left).

## 5.5 Programming Cable

Connection to a PC requires the following cable with SUB-D 9 F connectors. The TxD and RxD signals of the LDM41P and LDM42P and the PC connection are crossed. The colours apply to the optional programming cable.

**Table 6 : Pin assignment programming cable**

| Pin LDM 4xP | Description | Colour | Pin SUB-D 9 F | Description |
|---|---|---|---|---|
| 1 | RxD | brown | 3 | TxD |
| 2 | TxD | white | 2 | RxD |
| 3 | GND | blue | 5 | GND |

## 5.6 Shield and Grounding

Cable shields must be grounded with low resistance. Only high quality shielded cables should be used.

Carrier bases and control boxes should have equal potential. Potential differences could lead to electrical currents and may cause EMC problems (no correct measurement function or switching the gauge off or on is necessary).

If no potential equalization is possible, then mount the LDM41P and LDM42P isolated from the carrier base (use nylon screws and washers). Connect the screen with mass to the cable end. This way of assembly should also be used when installing the LDM41P and LDM42P inside vehicles.

# 6 Limiting Values for Voltages

**Input voltages:**

**Table 7 : Input voltages**

| Terminal point | Voltage | Comment |
|---|---|---|
| VCC | +10 V ... +30 V | Pole-reversal-protected |
| TxD | ±13.2 V | Short-circuit-proof |
| RxD | ±25 V | Short-circuit-proof |
| TRIG[11] | ±25 V | Short-circuit-proof |

**Output voltages:**

**Table 8 : Output voltages**

| Terminal point | Voltage | Comment |
|---|---|---|
| TxD | ±5.4 V | ± 5 V at 3 kΩ load |
| Alarm | ≥ VCC – 2 V | Level depending on VCC |

Limiting values of voltages, loads and logical levels comply with relevant RS232 and Profibus standards.

[11] Trigger function is not available for devices with internal heating (LDM41P-h and LDM42P-h)

# 7 Start up

Ensure that all cable ends are protected against short circuit prior to turning on the power supply!

Connect cable terminals as required for the particular operating mode. A pole-reversal protection is included so as to prevent the destruction of electronic components.

Connection to the Profibus master should only take place following start up!

**Note:** Please turn on the LDM41P and LDM42P prior to connecting the Profibus. **The receiving line of the RS232 serial interface is deactivated after connecting to the Profibus master.**

Turning on the LDM41P and LDM42P requires a **PC with a corresponding COM1 data interface**, an **optional programming cable** and a terminal programme. We recommend the use of the following programme: **LDMTOOL (Version 4.5 or higher)**.

When turning on the LDM41P and LDM42P, it must be properly installed at the designated operation site, aimed at the target, and kept in a stable position. Targets to be measured (e.g. machine or system components) should preferably have a light and homogeneous surface. Several optional reflex foils are available.

**Caution: Do no use any retro reflectors!**

Alignment of the LDM41P and LDM42P is facilitated by a visible laser beam[12] that can easily be turned on from a PC.

Operating voltage supply occurs via the power supply terminal (see Chapter 5).

[12] Depending on ambient light and target conditions

# 8 Parameters and Control via RS232

## 8.1 General

It is easy to configure the LDM41P and LDM42P by using a PC, as it provides a wide range of operating functions. Configuration should take place prior to connecting to the Profibus.

**Caution: If the LDM41P and LDM42P has been configured via the Profibus DP Master, then the PC interface (RS232) can no longer be used to enter commands.** However, the LDMTool programme can be used for display distance values.

By selecting the ID[Enter] command, you may call up the menu with the available set-up commands.

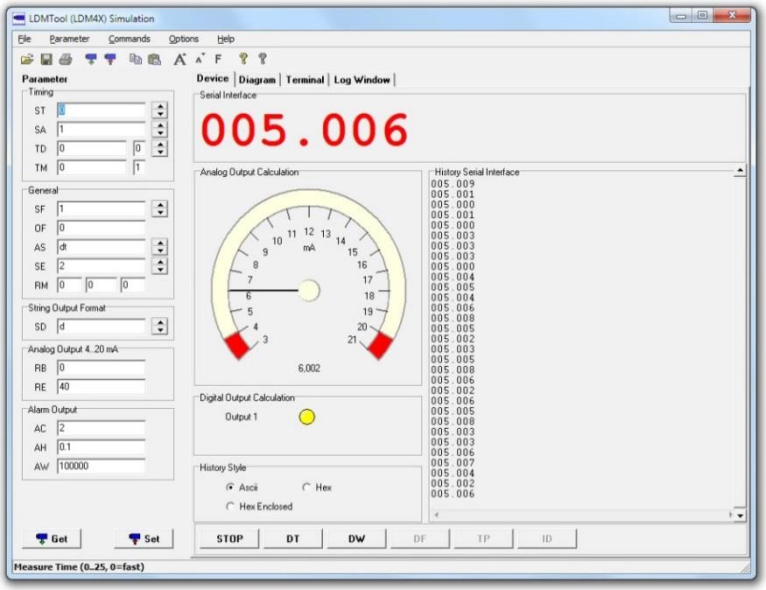



**Figure 7 : LDMTool**

**Note:** Configuration commands for the analogue output and digital alarm output cannot be used for the LDM41P and LDM42P. However,

they do ensure compatibility with the LDM41A and LDM42A (without Profibus DP).

Prior to commencing measurements, desired parameter settings can be entered via a smart selection procedure, so as to adapt the LDM41P and LDM42P in an optimal manner to specific environments and measuring tasks.

Such settings will be stored when turning off the LDM41P and LDM42P.

They can only be changed by entering new values or by reinstalling the standard parameter settings.

Command entries are not case-sensitive. This means that small and capital lettering can be used for commands.

Any command must be terminated by a hexadecimal 0Dh (carriage return) character.

Where decimal digits are to be entered, they must be separated by period (2Eh).

For command parameter entries, one must distinguish between parameter settings and parameter queries.

Querying is achieved with a command in simple format, e.g. (for alarm center parameters):

AC[Enter]

For parameter setting, a new value must be added after the command with no delimitation sign in between, for example:

AC20.8[Enter]

In the given example, the alarm center will be set to 20.8.

The following is a short overview of the commands:

**Table 9 : Command list LDM41P and LDM42P**

| Command | Description |
|---|---|
| **DT** | Start distance tracking |
| **DS** | Start distance tracking (< 7 m) |

| Command | Description |
|---|---|
| **DW** | Start distance tracking on white target at 10 Hz |
| **DX** | Start distance tracking on white target at 50 Hz (nur LDM42P) |
| **DF**[13] | Start remote triggered single distance measurement |
| **DM** | Start single distance measurement |
| **TP** | Queries inner temperature |
| **SA** | Queries/sets floating average value(1...20) |
| **SD** | Queries/set output format (**d**ez/**h**ex/**s**ig) |
| **ST** | Queries/set time to measure(0...25) |
| **SF** | Queries/set scale factor |
| **SE** | Queries/set Error Mode (0, 1, 2) |
| **AC** | Queries/set alarm center |
| **AH** | Queries/set alarm hysteresis |
| **AW** | Queries/set alarm width |
| **HO**[14] | Queries/set temperature for heating on |
| **HF**[14] | Queries/set temperature for heating off |
| **TD** | Queries/set trigger delay and level |
| **BR** | Queries/set baud rate |
| **AS** | Queries/set auto start |
| **OF** | Queries/set offset |
| **SO** | Sets current distance as offset |
| **LO** | Turns Laser on |
| **LF** | Turns Laser off |
| **PA** | Displays all parameter values |
| **PR** | Resets all parameters to standard values (don't use) |

[13] Trigger function is not available for devices with internal heating (LDM41P-h and LDM42P-h)
[14] Only for devices with internal heating (LDM41P-h and LDM42P-h)

## 8.2 DT – distance tracking

| | |
|---|---|
| Input parameter | SA, SD, SE, SF, ST, OF |
| Output | RS232/RS232, digital switching output, analog output |

DT mode can be chosen for distance measurement of different kinds of surfaces (varying reflectance). In this type of distance tracking mode, the LDM41P and LDM42P uses internal algorithms to continuously evaluate the quality of the Laser radiation signal that is coming back. This may cause longer measuring times in the case of poor reflectance or sudden jumps in distance.

The minimum time to measure is 240 ms, the maximum time is 6 s. If the measuring signal fails to reach a specified quality within six seconds, an error message is output.

The time to measure may also be limited by setting the ST parameter to a desired value. ESC stops the measurement.

## 8.3 DS – distance tracking (<7 m)

| | |
|---|---|
| Input parameter | SA, SD, SE, SF, ST, OF |
| Output | RS232/RS422, digital switching output, analog output |

Operation in DS mode makes sense where different types of surfaces have to be measured at close range up to 7 m. Compared to DT measuring mode, it allows a higher measurement rate. Within the range from 0.1 m to 0.5 m, measuring accuracy is restricted (± 4 mm). Measuring time (time to measure) can be limited via ST parameter settings.

ESC stops the measurement.

## 8.4 DW – distance tracking with target board (10 Hz)

| | |
|---|---|
| Input parameter | SA, SD, SE, SF, OF |
| Output | RS232/RS422, digital switching output, analog output |

DW mode performs at a steady measuring rate of 10 Hz. As a necessary precondition for measured values to be stable, a white target board must be placed at the selected object. There must be no sudden jumps in distance greater than 16 cm within the measuring field!

ESC stops the measurement.

## 8.5 DX – distance tracking with target board (50 Hz)

| | |
|---|---|
| Input parameter | SA, SD, SE, SF, OF |
| Output | RS232/RS422, digital switching output, analog output |

DX mode performs at a steady measuring rate of 50 Hz (only LDM42). As a necessary precondition for measured values to be stable, a white target board must be placed at the selected object.

This measurement mode is intended in the first place for objects performing homogeneous motion up to 4m/s. For higher rates of measurement, preceding measured values will be included in the process to calculate a currently measured value. There must be no sudden jumps in distance greater than 16 cm within the measuring field!

**Caution: To prevent transmission problems, please use 9600 baud as the minimal baud rate for DX Mode!**

## 8.6 DF – distance measurement with external trigger[15]

| | |
|---|---|
| Input parameter | SD, SE, SF, ST, OF, TD, ST, SA, RM |
| Output | RS232/RS232, digital switching output, analog output |

DF mode allows a measurement that is triggered by an external trigger pulse.

Initially, after selecting this mode, the operator does not receive any response. As soon as the trigger pulse has been detected, the LDM41P and LDM42P will send data and switches to digital and/or analog output.

Settings for trigger delay (delay) and trigger slope can be defined via parameter TD (see 8.19 TDx y – display/set trigger delay trigger level).

With ST=1 the maximum trigger frequency should not exceed 3.5 Hz.

[15] Trigger function is not available for devices with internal heating (LDM41P-h and LDM42P-h)

## 8.7 DM – distance measurement

Input parameter SD, SE, SF, ST, OF
Output RS232/RS232, digital switching output, analog output

DM mode triggers a single measurement (single shot)

## 8.8 TP – internal temperature [°C]

TP queries the value of the inner LDM41P and LDM42P temperature.

Note: In tracking mode, the inner temperature may exceed the surrounding temperature level by as much as 10 K.

## 8.9 SA – display/set average value [1..20]

SA allows you to calculate a floating average value from 1 to 20 measured values. Calculation is based on this formula:

Average value: $$x = \frac{x_1 + x_2 + x_3 + \ldots + x_{n(20)}}{n}$$

Standard setting is 1 (no average).

## 8.10 SD – display/set display format [d/h/s}]

SD selects the output format of measured value data. There are three modes available:

**Table 10 : Output format**

| Parameter | Output | Format |
|---|---|---|
| d | decimal | xxx.xxx<CR><LF><br>x=0…9 |
| h | hexadecimal | <SPACE>xxxxxx<CR><LF><br>x=0...F |
| s | decimal with signal quality | xxx.xxx<SPACE>yyyyyy<CR><LF><br>x=0…9; y=0…9 |

SD affects all commands that output a distance value.

An output value is calculated from a given measured distance value (in mm), multiplied by the scale factor SF.

Negative distance values are output in two's complement notation.

The value for the signal quality varies between 0 and 1024. 0 means a bad signal quality while 1024 indicates a very good signal quality.

Examples:

Distance = 4,996 m, SF1

dec: 004.996<CR><LF>

hex: <SPACE>001384<CR><LF>

(= 4996 mm × SF1)

dec+sig: 004.996_000005<CR><LF>

(bad signal quality)

dec+sig: 004.996_000985<CR><LF>

(good signal quality)

Distance = 4,996 m, SF10

dec: 049.960<CR><LF>

hex: _00C328<CR><LF>

(= 49960 = 4996 mm × SF10)

dec+sig: 049.960_000005<CR><LF>

Error case

dec/hex: E15<CR><LF>

(see 11 Error Codes RS232 and Profibus)

## 8.11 ST – display/set measure time [0..25]

Measuring time is directly conditional on the selected measuring mode. As a general rule, one may say: the poorer the reflectance of the surface of a particular target, the more time the LDM41P and LDM42P will require to determine the distance with specified accuracy. For example, if error message E15 is output because of poor reflectance and insufficient time to measure, this latter setting must be increased.

The available value range for measuring time is 0 to 25. Basically, the greater the time setting is the more time will be available for measurement and the lower the resulting measuring rate.

An exception there from is zero-value. In this case, the LDM41P and LDM42P automatically picks the smallest possible time value for measurement!

The LDM41P and LDM42P comes factory-set with ST = 0.

ST is effective in the DT, DF and DM mode of operation.

The measuring time setting option can also be used to modify the measuring rate, for example, in order to restrict the data volume or for synchronization purposes. Measuring time can only be set as an approximate value, because the underlying principle of measurement is subject to certain variances that cannot be accounted for:

DT measuring mode → measuring time= ST x 240 ms (except ST = 0)

DS measuring mode → measuring time = ST x 150 ms (except ST = 0)

Example:

The target distance is 25 m, but the target's reflectance is not ideal. With a measuring time setting of ST 2, E15 will be output following measurement. The user must increase the time (ST > 2) or set auto (ST 0) to measure in this case!

**One should work in DW or DX measuring mode where stable measuring times are required.**

## 8.12 SF – display/set scale factor

SF multiplies a calculated distance value with a user-selectable factor for changes in resolution or outputs in a different unit of measure. The scale factor may also be negative. Standard setting is 1.

The scale factor influence the output of measurement results, Offset (OF), Alarm Centre (AC), Alarm Hysteresis (AH), Range Begin (RB) and Range End (RE)!

**Table 11 : Examples of scale factor**

| Scale factor | Resolution | Output | Output Unit |
|---|---|---|---|
| SF1 | 1 mm | 012.345 | m |
| SF10 | 0.1 mm | 123.450 | dm |
| SF1.0936 | 0.01 yard | 013.500 | yard |
| SF3.28084 | 0.01 feet | 040.501 | feet |
| SF0.3937 | 1 inch | 004.860 | 100 inch |
| SF-1 | 1 mm | -12.345 | m |

**Note: Following a change in the scale factor, the settings for digital and/or analog output and offset must be matched accordingly!**

## 8.13 SE – display/set error mode [0/1/2]

SE (error mode) allows you to configure the behaviour of the digital switching output (alarm) and/or the analog output following an error message (E15, E16, E17). Depending on the particular LDM41P and LDM42P application environment, error messages have to be handled in different ways.

Available setting options are 0, 1 and 2 with the following effects in the case of an error:

**Table 12 : Meaning of SE**

| SE | Digital switching output (Alarm) | Analog output (4 -20 mA) |
|---|---|---|
| 0 | ALARM of latest valid measurement | Outputs current of last valid measurement |
| 1 | Positive alarm hysteresis = LOW<br>Negative alarm hysteresis = HIGH | RE >RB: Current =3 mA<br>RE <RB: Current =21 mA |
| 2 | Positive alarm hysteresis = HIGH<br>Negative alarm hysteresis = LOW | RE >RB: Current =21 mA<br>RE <RB: Current =3 mA |

## 8.14 AC – display set ALARM center

AC sets the beginning of the distance range, for which the switching output will be turned active. The length of this active range can be set using the AW parameter.

AC must be selected in keeping with the currently set SF scale factor (see **9.4 Digital Switching Output (Alarm)**).

## 8.15 AH – display/set ALARM hysterese

AH allows you to make parameter settings for the switching hysteresis at the beginning and the end point of the active range of the switching output.

AH must be selected so it is properly matched to the currently valid scale factor (SF).

The mathematical sign of AH can be used to set an active state logic level:

Positive sign (“+”): active range is HIGH-active.

Negative sign (“-“): active range is LOW-active.

No sign setting means positively-signed (see **9.4 Digital Switching Output (Alarm)**).

## 8.16 AW – display/set ALARM width

AW pa ets the length of the active range, beginning at AC.

AW settings must be made in agreement with the currently valid SF scale factor.

AW is always equal or greater than “0” (zero).

AW is always equal or greater than |AH| (the amount of AH).

Standard setting is 100000 – means off.

## 8.17 HO – display/set Temperature for heating on[16]

HO displays/sets the temperature value at which the internal heating is switched on. The values can be varied between -40°C and 70°C.

Standard setting is 3°C.

[16] Only for devices with internal heating (LDM41P-h and LDM42P-h)

## 8.18 HF – display/set Temperature for heating off [16]

HF displays/sets the temperature value at which the internal heating is switched off. The values can be varied between -40°C and 70°C. Standard setting is 12°C.

## 8.19 TDx y – display/set trigger delay trigger level[17]

TD is only intended for the configuration of the remote trigger input (see 8.6 DF – distance measurement with external trigger).

TD consists of two sub parameters, of the actual delay value, i.e. the delay time, and the trigger level.

Trigger delay corresponds to the time from arrival of the trigger signal to the starting point of a measurement. It may be set to any value between 0 and 9999 ms. With the help of the trigger level one may define if measurement is to begin on a rising or a falling pulse slope.

Trigger delay and trigger level must be separated by space (20h) in the entry line. Standard setting: 0 0.

x Delay time between trigger signal and start of measurement, delay can be set from 0 to 9999 ms.

y 0 for HIGH → LOW-slope
1 for LOW → HIGH-slope

Example:

TD1000_0[Enter]

In the given example, the delay has been set to 1000 ms and the trigger slope to "rising" (LOW-to-HIGH transition)

## 8.20 BR – display/set baud rate [2400..38400]

Available baud rate settings are: 2400, 4800, 9600, 19200, 38400. Faulty entries will be rounded to the nearest baud rate. A fixed data format of eight

[17] Trigger function is not available for devices with internal heating (LDM41P-h and LDM42P-h)

data bits, with no parity and one stop bit is used. Standard setting is 9600 baud.

## 8.21 AS – display/set autostart command

AS (auto start) defines which function will be carried out when power becomes available to the LDM41P and LDM42P.

Possible entries are those delivering a measured value on the output side, an ID command or the command for turning the Laser on (LO).

For example, if ASDT has been parameterized, the LDM41P and LDM42P will begin with distance tracking on turning on power.

## 8.22 OF – display/set distance offset

With the help of OF (offset) the user may define a zero-point for his/her application. For details on the position of the module's zero-point, refer to section 4.

OF must be selected so it is properly matched to the currently valid scale factor setting (SF).

OF may also take on negative values. Standard setting: 0

## 8.23 SO – set current distance to offset

SO performs a distance measurement and saves the measured reading as an offset value with inverted mathematical sign (OF).

## 8.24 LO – Laser on

LO turns the Laser on. This function can be used for orientation or functional testing of the LDM41P and LDM42P. After the command LO it's necessary to send LF! Don't use LO because this. Please use instead of LO the command DT to turn the Laser on.

## 8.25 LF – laser off

LF turns the Laser off.

## 8.26 PA – display settings

PA lists all parameters in a table.

## 8.27 PR – reset settings

PR resets all parameters (except baud rate). After this a new configuration of the LDM41P and LDM42P is necessary

```
average value[SA].................1
display format[SD]................d
measure time[ST]..................0
scale factor[SF]..................1
error mode[SE]....................1
ALARM center[AC]..................1000
ALARM hysterese[AH]...............0.1
ALARM width[AW]...................100000
distance of Iout=4mA [RB].........1000
distance of Iout=20mA [RE]........2000
remove measurement [RM]...........0 0 0
trigger delay, trigger level[TD]..0 0
trigger mode, trigger level[TM]...0 1
baud rate[BR].....................9600
autostart command[AS].............ID
distance offset[OF]...............0
```

**Use instead of PR the "Set Standard" command from Windows program LDMTool.**

# 9 Interface Connection

## 9.1 Profibus DP

### General

The LDM41P and LDM42P is operated as a standard Profibus slave. It becomes operational with master 13 byte entry data: 2x 8 bit error information, 16 bit measurement value counter, 32 bit time stamp, 32 bit distance and 8 bit internal temperature are available.

One byte of output data is used for control. It is possible to switch between various measurement modes. In addition, the internal equipment temperature can be measured and the laser can be turned off.

Bus rates of up to 12 Mbaud (autodetect) are supported. The slave address is provided via the bus. ***The slave address will be set via Profibus*** (e.g. Siemens PG other master with SET_SLAVE_ADD_REQ).

Connection takes place via circular plug-in connectors that are in compliance with relevant standards. If only one Profibus is used, then a terminal resistance should be attached to the other Profibus.

Configuration of measuring time, scaling, etc., takes place via the serial interface (see Chapter 8).

### Parameter Setting

The LDM41P and LDM42P is configured as a standard Profibus slave. The standard mode transfers binary data from the Profibus. In the ASCII mode, the ASCII values are transferred in the way they are transferred from the LDM 4x P (only for special applications).

**Note:** Please ensure that the parameter setting of the LDM 4x P is correct. The parameter baud rate (BR9600) and output format (SDh) must be set via the serial RS232 interface of the LDM 4x P by using a PC and the LDMTool programme, or alternatively a terminal program, prior to connection to the Profibus Master!

**Table 13 : Meaning of Profibus DP modes**

| Modes | Profibus IN | Profibus Configuration | Profibus Configuration Bytes |
|---|---|---|---|
| **Standard** | **8 bit Error Counter**<br>**8 bit Error Code**<br>**16 bit Counter**<br>**32 bit Time Stamp**<br>**32 bit Distance**[18]<br>**8 bit Temperature**[19] | 13 byte IN<br>1 byte OUT | 156 32 0<br>(0x9C 0x20 0) |
| ASCII | 16 bit Counter<br>32 bit Time Stamp<br>8 bit Number of Character n<br>n byte ASCII Character | 32 byte IN<br>0 byte OUT | 223 0 0<br>(0xDF 0 0) |

### Profibus IN, Explanation of Error Codes

**Table 14 : Profibus error codes**

| Code | Description |
|---|---|
| 0 (0x00) | Received valid measurement value; Error Counter and Code are set to zero |
| 15 (0x0F) | Reflexes too weak, use target board[20] or distance from LDM (front edge) is out of range |
| 16 (0x10) | Reflexes too strong, use target board |
| 17 (0x11) | Too much constant light (e.g. sun) |
| 23 (0x17) | Temperature below - 10 °C |
| 24 (0x18) | Temperature above + 50 °C |
| 61 (0x3D) | Faulty command |
| 255 (0xFF) | Invalid string from LDM 4x P (e.g. hexadecimal output has not been set) |

### Profibus IN, Explanation of Additional Binary Values

Error Counter Number of errors after last valid measurement value

Counter Increased for each new valid measurement value

[18] Scaling depends on LDM 4xP parameter settings
[19] Displays the internal temperature in °C, if the control byte has been set on the TP mode, activation HI/LO slope bit 6
[20] E.g. 3M, self-adhesive, white non-glossy foil

Time Stamp Set for each new valid measurement value (ms)

### Profibus OUT, Explanation of Control Byte

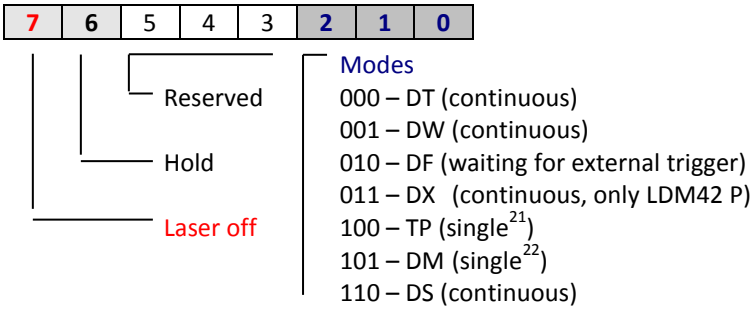
The control byte sets the **Measuring Mode** via **Bit 0 to 2**. For a description of the various **Modes**, please see Chapter 8.

**Bit 3 to 5** are reserved and can be set to 0.

If **Bit 6** has been set to 1, then the actual measuring value is kept. If Bit 6 is set from 0 to 1, the 1/0 slope is also activated. This slope will provide a new measurement for the DM single measurement mode and TP temperature measurement. For all other modes, Bit 6 generally remains set at 0.

To turn off the **Laser** and switch the LDM41P and LDM42P to **standby operation**, **Bit 7** should be set at 1. The remaining bits have no meaning.

If all bits are set at 0, then the LDM41P and LDM42P will operate in the DT mode (Distance Tracking, continuous measurement).




## 9.2 Serial Interface RS232

Initially, RS232 communication interfaces purely functioned as PC communication ports. They have become the established standard tool for serial data transmission over short cable lengths. With greater transmission lengths, the interface is highly susceptible to interferences, notably, in the vicinity of strong electromagnetic noise emitters.

Therefore, it should only be used for LDM41P and LDM42P configuration.

[21] New temperature measurement (second and subsequent) at Bit 6 Hold (1/0 slope)
[22] New distance measurement (second and subsequent) at Bit 6 Hold (1/0 slope)

The commands of the serial interface are described in chapter 8 starting page 21. The data output format is determined by parameter SD (display format), see page 26.

## 9.3 Output Format Ethernet and RS232

The output format on the serial interface is selected by the command SD. There are three modes available:

| Parameter | Output | Format |
|---|---|---|
| d | decimal | xxx.xxx<CR><LF><br>x=0…9 |
| h | hexadecimal | <SPACE>xxxxxx<CR><LF><br>x=0...F |
| s | Decimal with signal quality | xxx.xxx<SPACE>yyyyyy<CR><LF><br>x=0…9; y=0…9 |

SD affects all commands that output a distance value.

An output value is calculated from a given measured distance value (in mm), multiplied by the scale factor SF.

Negative distance values are output in two's complement notation.

The value for the signal quality varies between 0 and 1024. 0 means a bad signal quality while 1024 indicates a very good signal quality.

Examples:

Distance = 4,996 m, SF1

dec: 004.996<CR><LF>

hex: <SPACE>001384<CR><LF>
(= 4996 mm × SF1)

dec+sig: 004.996_000005<CR><LF>
(bad signal quality)

dec+sig: 004.996_000985<CR><LF>
(good signal quality)

Distance = 4,996 m, SF10

dec: 049.960<CR><LF>

hex: _00C328<CR><LF>
(= 49960 = 4996 mm × SF10)

dec+sig: 049.960_000005<CR><LF>

Error case

dec/hex: E15<CR><LF>

(see page 42, chapoter 11, Error Codes RS232 and Profibus)

## 9.4 Digital Switching Output (Alarm)

With the help of a user-selectable distance threshold, the switching output can be set to monitor objects or conditions for positive or negative overstep.

For example, using the digital switching output, an object which was selected for measurement can be monitored for excision of a threshold value. To do this, parameter settings for a measurement window are required. Settings for this window can be made via the three parameters: Alarm Center (AC), Alarm Hysteresis (AH) and Alarm Width. The range which will be subject to monitoring begins at AC and ends at AC+AW. Switching transitions can be set via parameter AH.

The logic state of the switching output follows from the mathematical sign of AH.

In the case of a positive AH, the output switches

- with increasing distance:

  - from LOW to HIGH if the distance is greater than (AC ±AH/2)
  - from HIGH to LOW if the distance is greater than (AC+AW+AH/2)

- with decreasing distance:

  - from LOW to HIGH if the distance is smaller than (AC +AW-AH/2)
  - from HIGH to LOW the distance is smaller than (AC-AH/2)

In the case of a negative AH, the output switching pattern will be inverse.

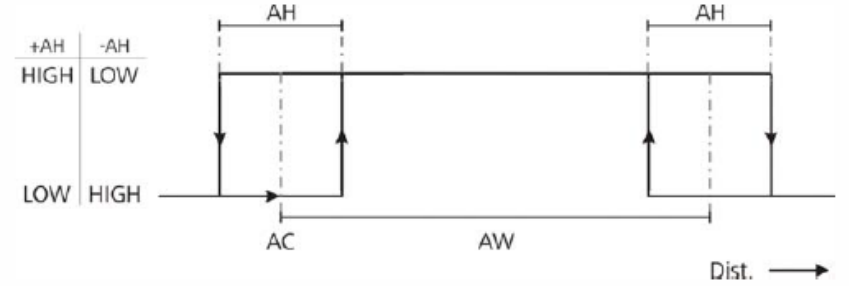



**Figure 8 : Digital switching output behavior with positive and negative hysteresis**

Example:

A moving object is assumed to be monitored within a window of 10 m to 11 m with a hysteresis of 0.2 m.

AC10
AH0.2
AW1

| Distance (m) increases → | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 9.8 | 9.9 | 10.0 | 10.1 | 10.2 | ... | 11.0 | 11.1 | 11.2 | 11.3 |
| +AH | L | L | L | H | H | H | H | L | L | L |
| -AH | H | H | H | L | L | L | L | H | H | H |

| Distance (m) decreases → | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 11,3 | 11,2 | 11,1 | 11,0 | 10,9 | 10,8 | ... | 10,0 | 9,9 | 9,8 |
| +AH | L | L | L | L | H | H | H | H | H | L |
| -AH | H | H | H | H | L | L | L | L | L | H |

*L = LOW, H = HIGH*

How the switching output is to behave on occurrence of an error message (E15, E16, E17, E18) can be defined by making suitable settings under “SE“ (see 8.13, SE – display/set error mode [0/1/2])

## 9.5 Trigger Input[23]

The trigger input is intended for triggering a distance measurement with an external signal that is applied as a voltage pulse between 3 V and 24 V. This input is used only in trigger mode DF (DF – distance measurement with external trigger)!

It is for the user to specify a desired delay time and a pulse slope to be selected for synchronization (see 8.19, TDx y – display/set trigger delay trigger level). The distance measurement will always be started with a delay of 5 ms in addition with the programmed trigger delay time.

Having done this, the LDM41P and LDM42P has to be switched to trigger mode (see 8.6, DF – distance measurement with external trigger).

[23] Trigger function is not available for devices with internal heating (LDM41P-h and LDM42P-h)

# 10 List of Commands

**Table 15 : LDM41P and LDM42P command list**

| Command | Description |
|---|---|
| **DT** | Starts distance tracking |
| **DS** | Starts distance tracking (< 7 m) |
| **DW** | Starts distance tracking on white target at 10 Hz |
| **DX** | Starts distance tracking on white target at 50 Hz (only LDM42P) |
| **DF** | Starts remote-triggered single distance measurement (single shot) |
| **DM** | Starts single distance measurement (single shot) |
| **TP** | Queries inner temperature |
| **SA** | Queries / sets floating average value (1...20) |
| **SD** | Queries / sets output format (dec/hex/sig) |
| **ST** | Queries / sets time to measure (0...25) |
| **SF** | Queries / sets scale factor |
| **SE** | Queries / sets error mode (0, 1, 2) |
| **AC** | Queries / sets alarm center |
| **AH** | Queries / sets alarm hysteresis |
| **AW** | Queries / sets alarm with |
| **HO**[24] | Queries / sets temperature for heating on |
| **HF**[23] | Queries / sets temperature for heating off |
| **TD** | Queries / sets trigger delay and level |
| **BR** | Queries / sets baud rate |
| **AS** | Queries / sets auto start |
| **OF** | Queries / sets offset |
| **SO** | Sets current distance as offset |
| **LO** | Turns Laser on (do not use, please use DT) |
| **LF** | Turns Laser off |
| **PA** | Displays all parameter values |
| **PR** | Resets all parameters to standard values (don't use) |

[24] Only for devices with internal heating (LDM41P-h and LDM42P-h)

# 11 Error Codes RS232 and Profibus

**Table 16 : Error codes**

| Code | Description | Action |
|---|---|---|
| **E15** | Reflexes are too weak, **or** distance from LDM (front edge) to target is less than 0.1 m | Use white target board[25] **or** increase distance to target |
| **E16** | Reflexes are too strong | Use white target board or filter |
| **E17** | Too much steady light (e.g. sun) or reflexes are too strong | Use aperture or filter or white target board |
| **E18** | DX mode (**only LDM42P**): reflexes too weak, **or** distance from LDM (front edge) to target is less than 0.1 m | Use white target board **or** increase distance to target |
| **E23** | Inner temperature below – 10°C | Heading necessary |
| **E24** | Inner temperature above + 60°C | Cooling necessary |
| **E31** | EEPROM checksum error | Necessary to repair |
| **E51** | Failed to set avalanche voltage | Necessary to repair |
| **E52** | Excessively high Laser current / Laser defect | Necessary to repair |
| **E53** | Division by 0 | SF must be unequal of zero or necessary to repair |
| **E54** | Hardware error, PLL range | Necessary to repair |
| **E55** | Other hardware error | Necessary to repair |
| **E61** | Invalid command | Correct input |
| **E62** | Wrong parameter, wrong command | Check data transmission |
| **E63** | SIO overflow | Check data transmission |
| **E64** | SIO framing error | Check data transmission |

[25] e.g. 3M, self adhesive foil matte white

# 12 GSD Data

```
;=============================================================
; Profibus Device ASTECH Unigate for LDM4xA and LDM4xP
; Model : LDM 4x Series
; Description : LDM 4x Series with Profibus-DP
; Language : English
; Date : 6 September 2005
; Author : ASTECH GmbH
;=============================================================

#Profibus_DP

GSD_Revision        = 1

; Device identification
Vendor_Name         = "ASTECH"
Model_Name          = "LDM4xP"
Revision            = "V2.0"
Ident_Number        = 0x2079
Protocol_Ident      = 0
Station_Type        = 0
FMS_supp            = 0
Hardware_Release    = "Revision D"
Software_Release    = "V2.0"

; Supported baudrates
9.6_supp            = 1
19.2_supp           = 1
93.75_supp          = 1
187.5_supp          = 1
500_supp            = 1
1.5M_supp           = 1
3M_supp             = 1
6M_supp             = 1
12M_supp            = 1

; Maximum responder time for supported baudrates
MaxTsdr_9.6         = 60
MaxTsdr_19.2        = 60
MaxTsdr_93.75       = 60
MaxTsdr_187.5       = 60
MaxTsdr_500         = 100
MaxTsdr_1.5M        = 150
MaxTsdr_3M          = 250
MaxTsdr_6M          = 450
MaxTsdr_12M         = 800

; Supported hardware features
Redundancy          = 0       ; not supported
Repeater_Ctrl_Sig   = 0       ; not supported
24V_Pins            = 0       ; not connected
Implementation_Type = "SPC3"
```

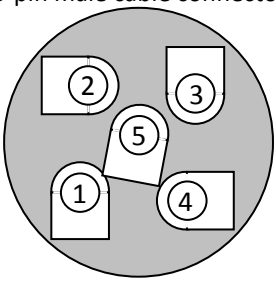
```
Bitmap_Device       = "LDM4xP_"

; Supported DP features
Freeze_Mode_supp    = 1
Sync_Mode_supp      = 1
Auto_Baud_supp      = 1
Set_Slave_Add_supp  = 1

; Maximum polling frequency
Min_Slave_Intervall = 1       ; 100 us

; Maximum supported sizes
Modular_Station     = 1       ; modular
Max_Module          = 1
Max_Input_Len       = 244
Max_Output_Len      = 244
Max_Data_Len        = 432
Modul_Offset        = 0

Fail_Safe           = 0       ; state CLEAR not accepted
Slave_Family        = 9
Max_Diag_Data_Len   = 8

; Definition of modules
Module = "Standard: 1/1/2/4/4/1 Byte" 0x9C,0x20
EndModule
Module = "------------------------------" 0x00,0x00
EndModule
Module = "ASCII: 2/4/1/25 Byte" 0xDF,0x00,0x00
EndModule

;=============================================================


Bitmap LDM4xP_N.bmp
```

**Figure 9 : GSD data and bitmap**

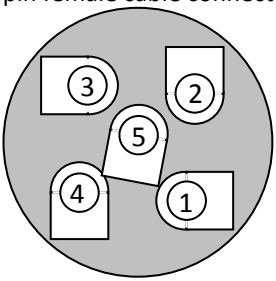
# 13 Contact Assignment for Cable Connectors

Numbers are displayed **when looking at the terminal side**.

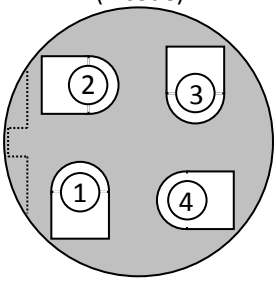
RS232
5-pin male cable connector




Power supply and Trigger
5-pin female cable connector




Profibus Output
4-pin male cable connector
(B code)




Profibus Input
4-pin female cable connector
(B code)

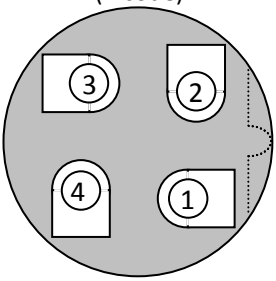



**Figure 10 : Contact assignment**

# 14 EG Declaration of Conformity

CE

In accordance with the

Directive of Electromagnetic Compatibility 2004/108/EG

The company ASTECH Angewandte Sensortechnik GmbH in Schonenfahrerstr. 5, 18057 Rostock / Germany herewith declare, represented by the signatory, that the following designated product

**Laser Distance Measurement Sensor**

**LDM41 A / LDM42P**

agree with the following harmonized standard:

**IEC 61326-1**

**Electromagnetic interference and electromagnetic compatibility (EMC)**
***including radio interference**

Rostock, 21. September 2010

ASTECH Angewandte Sensortechnik GmbH

Jens Mirow

General Manager

# 15 Part Numbers

**Table 17 : Part numbers**

| Part-No. | Name |
|---|---|
| 12-2002-00 | LDM41P |
| 12-2003-00 | LDM42P |
| 12-2018-00 | LDM41P/h with heating |
| 12-2019-00 | LDM42P/h with heating |
| 15-0000-00 | Terminator for Profibus |
| 15-0014-00 | Male cable connector Profibus OUT, 4-pin, B-coded |
| 15-0015-00 | Female cable connector Profibus IN, 4-pin, B-coded |
| 15-0019-00 | PC-Programming cable RS232 5m |
| 15-2002-00 | Connection cable LDM41P and LDM42P, 5m |
| 15-2002-01 | Connection cable LDM41P and LDM42P, 10m |
| 11-0001-00 | USB-RS232 Interface converter, 0.2m |
| 12-2006-00 | Protection window Standard for LDM4x-Serie |
| 12-2006-01 | Protection window Quartz glass for LDM4x-Serie |
| 12-2006-02 | Protection window Sapphire glass for LDM4x-Serie |
| 12-2030-00 | Gray filter 2-fach for LDM4x-Serie |
| 12-2030-01 | Gray filter 4-fach for LDM4x-Serie |
| 12-2010-00 | Reflection foil matte/white, A4 |
| 12-2011-00 | Highly reflective foil silver, A4 |
| 12-2015-00 | Protection tube for pressure air for LDM4x-Serie |
| 11-0006-00 | ASTECH USB Stick (Documentation and Software) |
| 16-2001-01 | Printed Manual LDM41P and LDM42P, A5, DE |
| 16-2001-02 | Printed Manual LDM41P and LDM42P, A5, EN |
| 17-2000-00 | License number for PC-Software LDMTOOL for LDM3x und LDM4x |

Note: Several single sensors are also available as packages including sensor and cable, manual and CD (sets). Additionally are other protection enclosures with and without a thermostat available.